



Notes:

What is VaporGrip X?

- XtendiMax® With VaporGrip® Technology is a low volatility formulation which, when used per label guidelines, is safe and avoids effects on listed species.
- VaporGrip X (VGX, MON 51817) is a standalone adjuvant that allows additional VaporGrip to be added as a tank mix partner/adjuvant
- Regulatory and academic data show VGX further reduces volatility and symptomology
 - Tested as MON 51817 by 11 academics in 2019
 - Already enabled on XtendiMax tank mix website as an adjuvant as MON 51817
- EPA should consider VGX as a means to further improve the off-target movement (OTM) profile of dicamba as it evaluates re-registration



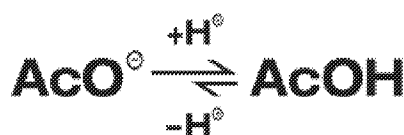
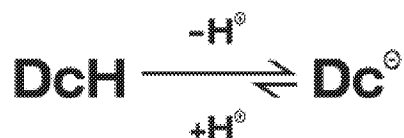
RESTRICTED

Notes:

- Goal is to improve grower confidence in using of the Xtend system.
- To that end, Bayer has explored numerous potential innovations, including modifications to dicamba formulations, digital solutions, providing spray nozzles
- The advancement we will discuss today, VGX, addresses improvements to the OTM profile for dicamba.
- VGX is Bayer's current internal project name for adding additional VaporGrip into an XtendiMax tank mix as a volatility reducing adjuvant
- Several benefits to this advancement:
 - No change in the formulation of XtendiMax
 - There are limitations as to what we can fit in the jug of chemistry
 - Having as an adjuvant allows us to be able to increase the amount of VaporGrip and has potential to be used across dicamba formulations
 - Available now on tank mix website
 - Ability to tank mix with a DRA and options for VGX/DRA in-can premixes
 - Not limited to Bayer products only
 - We've conducted Regulatory work and paired with some academics to test the product, all with positive results that show an improved OTM profile on top of our already low-volatile dicamba formulation, XtendiMax With VaporGrip Technology
- As data show further improved OTM profile and increased margin of safety of XtendiMax, the available data should be considered during re-registration decision making for dicamba

VaporGrip keeps dicamba in its non-volatile form in the jug and in the tank

- Acetate scavenges extraneous protons driving the dicamba equilibrium away from dicamba acid
- Adding extra VaporGrip provides additional buffering and proton-scavenging capacity to further keep the equilibrium shifted to the right in dicamba's non-volatile form as dicamba anion



	pK _a
Dicamba	1.87
Acetic Acid	4.75

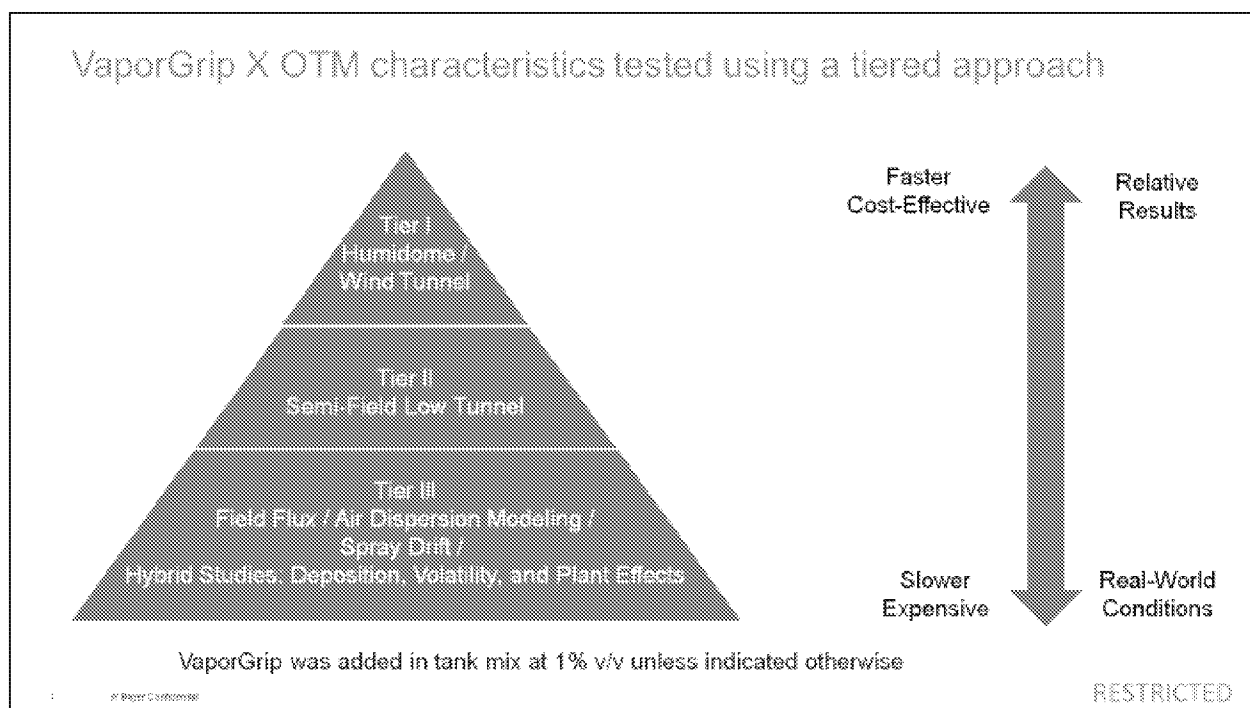
2

© Bayer Corporation 2000

RESTRICTED

Notes:

For the Xtendimax formulation, this is acid-base equilibria made of dicamba and acetic acid-acetate. Note that the pKa of acetic acid is 4.75 – approximately 3 log units above the pKa of dicamba acid. Therefore, the acid-base theory tells us that acetate anion is stronger base than the dicamba anion. The Xtendimax is formulated with VaporGrip to scavenge any extraneous protons and drive these equilibria to the right, thus limiting the formation dicamba acid (which is the volatile species) in the jug. Additional VaporGrip in the tank will further the buffering capacity to limit the volatile form of dicamba in the tank.

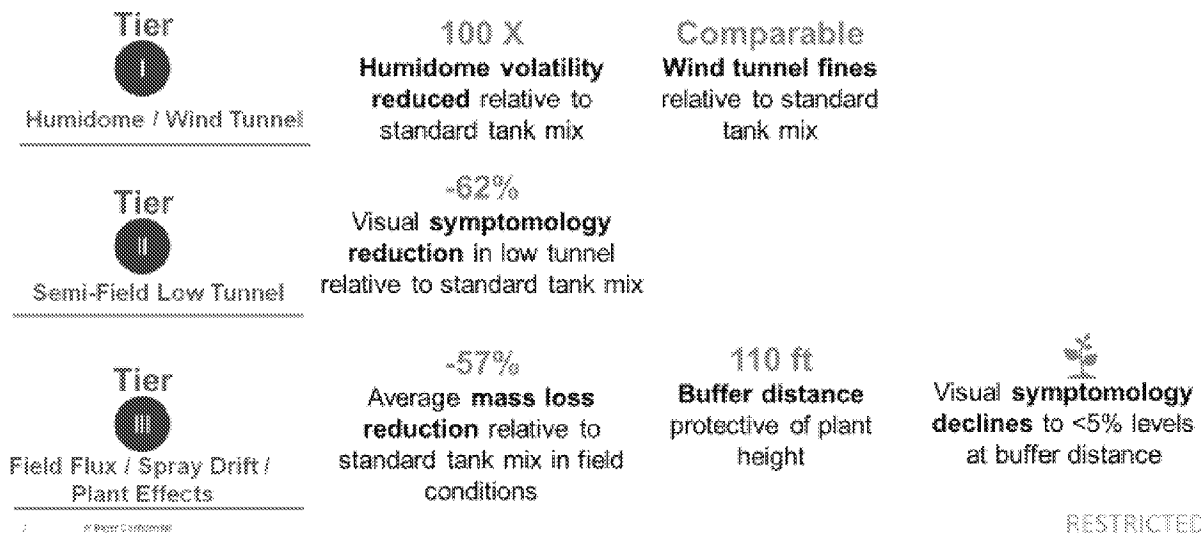


Notes:

A tiered testing approach was implemented to evaluate the off-target movement (OTM) characteristics of VaporGrip. Three tiers were implemented that increased in complexity and transition from understanding relative results in laboratory setting (tier I) to simultaneously evaluating spray drift, volatility, and plant effects in all directions over multiple days under real-world agronomic conditions (tier III).

- We focused our testing and this presentation to compare benefits relative to dicamba+glyphosate tank mix since it is widely used.
- We are referring to this as the standard tank mix in this presentation
- Most of the testing was conducted in collaboration with academics

Conclusion: VaporGrip X testing using a tiered-approach shows further improvement in OTM profile of dicamba

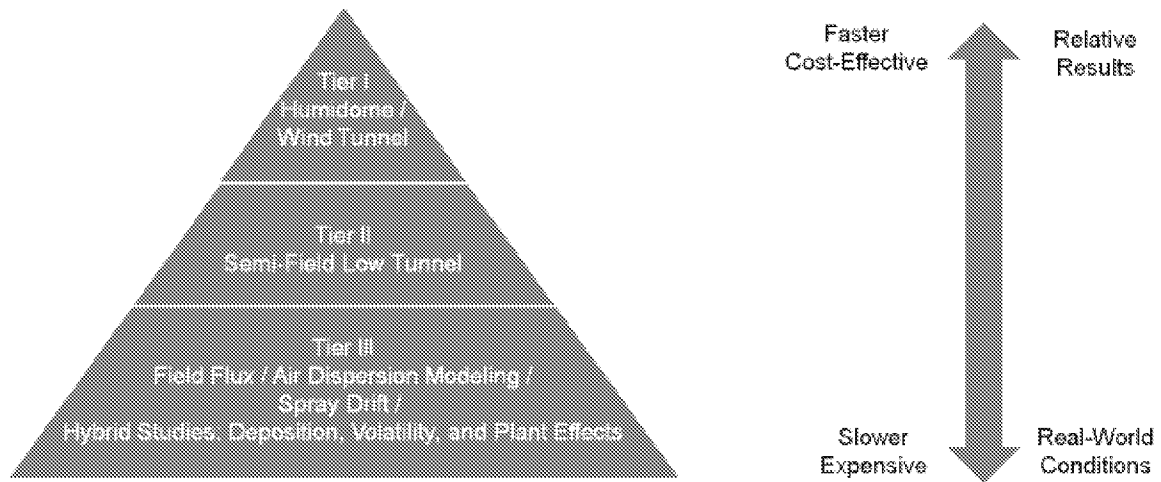


Notes:

Key points about this approach:

1. VGX was tested by Bayer and by academics
2. Data collected from the tiered approach were from laboratory and field studies, the latter of which were across multiple geographies
3. Data gathered from tiered approach collectively and consistently demonstrate that VGX reduces the OTM profile and increases the margin of safety of dicamba

VaporGrip X OTM characteristics tested using a tiered approach



2

© 2009 CropScience

RESTRICTED

Notes:

Tier I: Humidome method

- Closed dome containing soil sprayed with dicamba
- Air sampling conducted at 1.85 L/min for 24 hours using polyurethane foam (PUF) samplers
- PUFs analyzed for the dicamba residue
- Useful for relative volatility comparison



2009-09-01 10:00:00

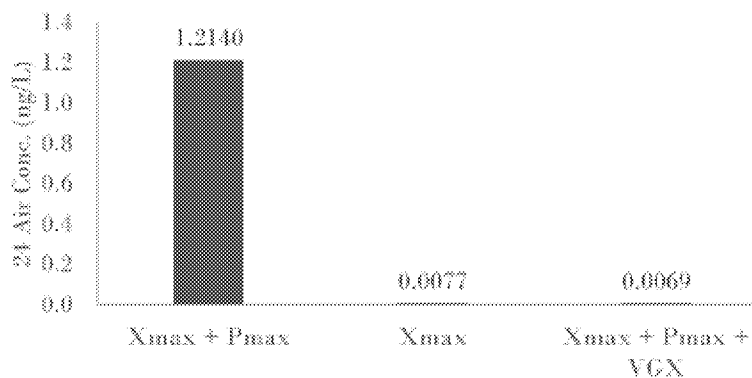
RESTRICTED

Notes:

Humidomes provide a screening-level test for understanding the relative volatility potential of formulations and tank mixes. Humidomes contain soil trays that are sprayed with the tank mix of interest. Air sampling is conducted for 24 hours following spray application and the PUFs are analyzed for dicamba residues.

Addition of VaporGrip X significantly reduces volatility of Xmax +Pmax tank mix in humidome

- Humidome testing with Xmax alone, Xmax + Pmax tank mix, and Xmax + Pmax + VGX tank mix
- Three replications for each test
- Adding additional VaporGrip results in about two orders of magnitude lower air concentration



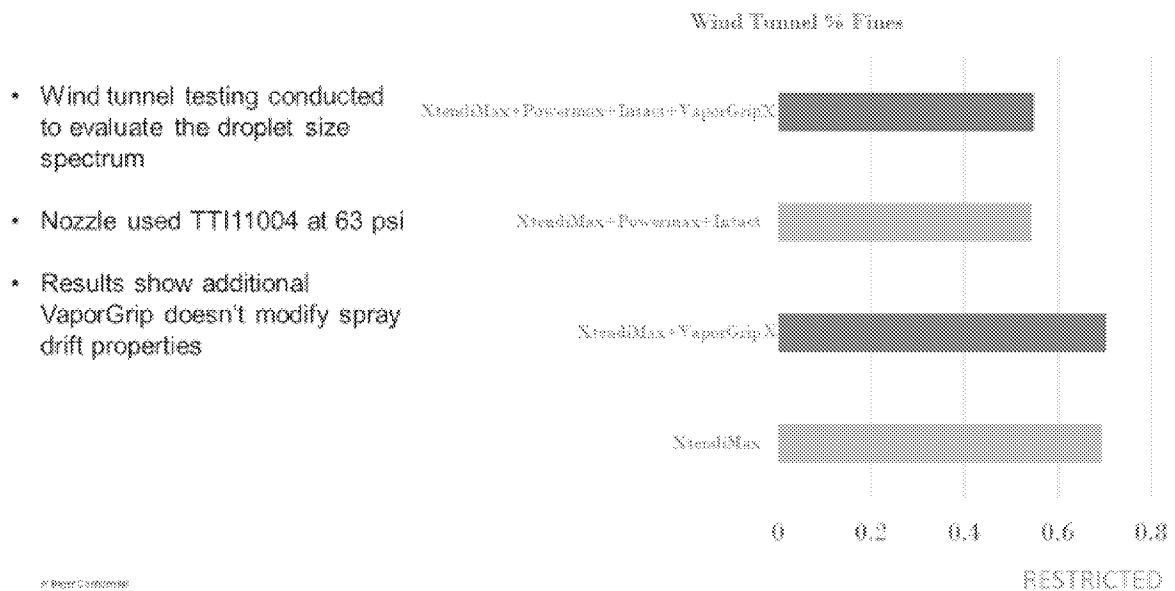
Xmax = Dicamba XtendiMax Formulation
Pmax = Glyphosate PowerMax Formulation
VGX = VaporGrip X

RESTRICTED

Notes:

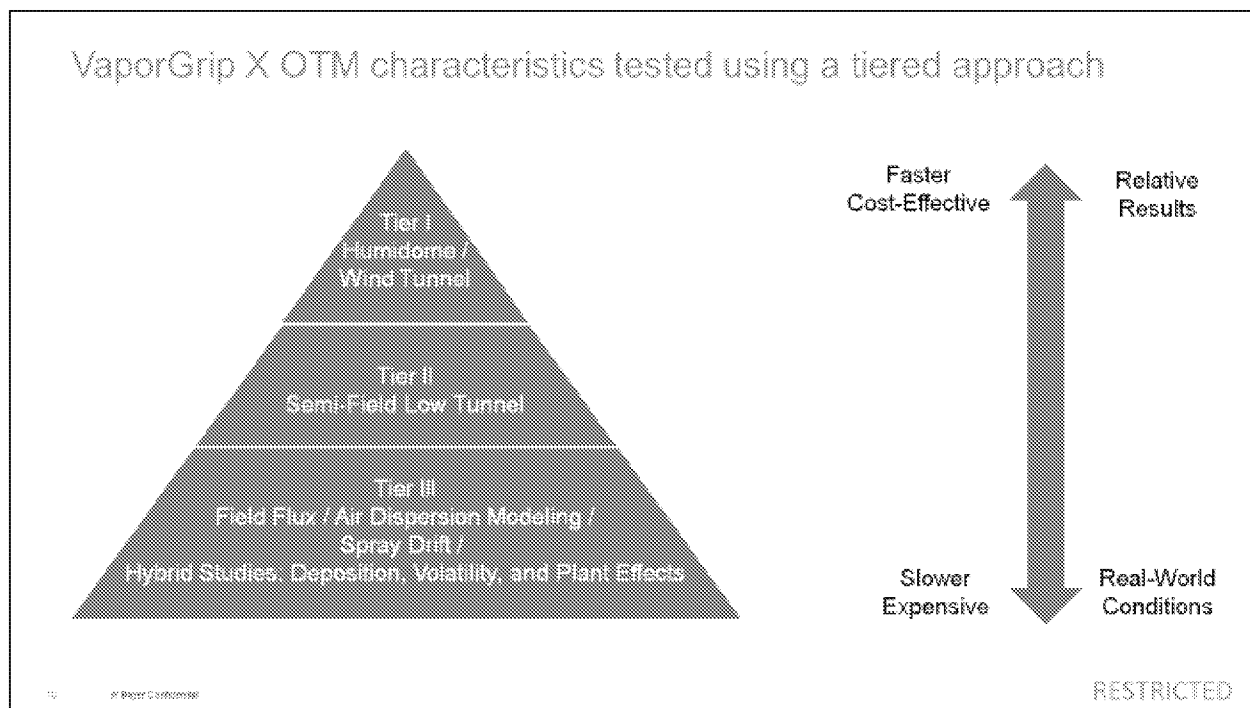
- Humidome studies allow for relative comparison of formulations or tank mixes
- Air concentrations reduced two orders of magnitude relative to Xmax+Pmax and brings it to same levels as Xmax only.

Addition of VaporGrip X results in comparable % fines in wind tunnel



Notes:

- Including additional VaporGrip as a tank mix adjuvant was tested in the wind tunnel to ensure that any spray drift properties are not changed.
- Results showed that % fines remained comparable with standard tank mix and XtendiMax alone.
- These were meant to be confirmatory studies – we did not expect VGX to modify any spray drift properties



Notes:

Low tunnel is a method developed by weed scientists to evaluate relative volatility.

Analogous to a humidome because the method provides relative results but conducted in the field and measures plant symptomology primarily.

Tier II: Academic low tunnel semi-field studies to understand plant effects from dicamba vapor

- Soil flats wetted to field capacity the night before trial
- Soil flats sprayed at 4x rates to assure symptomology
- Treatment:
 - XtendiMax (2 lb Dicamba/acre)
 - PowerMax (4.5 lb Glyphosate/acre)
 - VaporGrip X (4% v/v)
 - Intact (2% v/v DRA)
- Trays placed in low tunnel for 48 hours to expose plants to dicamba vapor
- Air temperature inside tunnel between 100 – 120 °F in many cases
- Plant visual ratings at 14 and 28 DAT

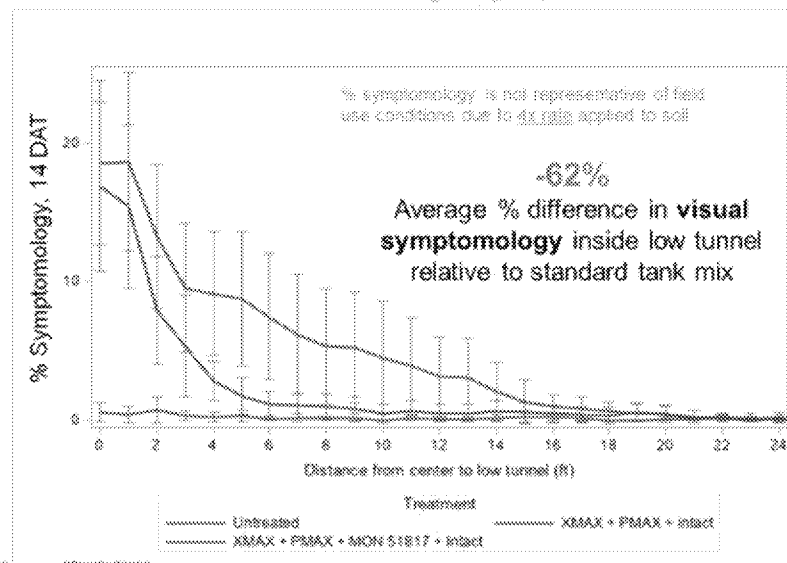


RESTRICTED

Notes:

Low tunnel studies are analogous to humidome because the method provides relative results but conducted in field and measures plant symptomology

11 academics confirmed lower symptomology with VaporGrip X in low tunnel studies over wide-geographical area



Academics	State
Reid Smeda	MO
Rodrigo Werle	WI
Dan Reynolds	MS
Steve Li	AL
Scott Nolte	TX
Christy Sprague	MI
Stanley Culpepper	GA
Mark Bernards	IL
Bob Hartzler	IA
Greg Kruger	NE
Bryan Young	IN

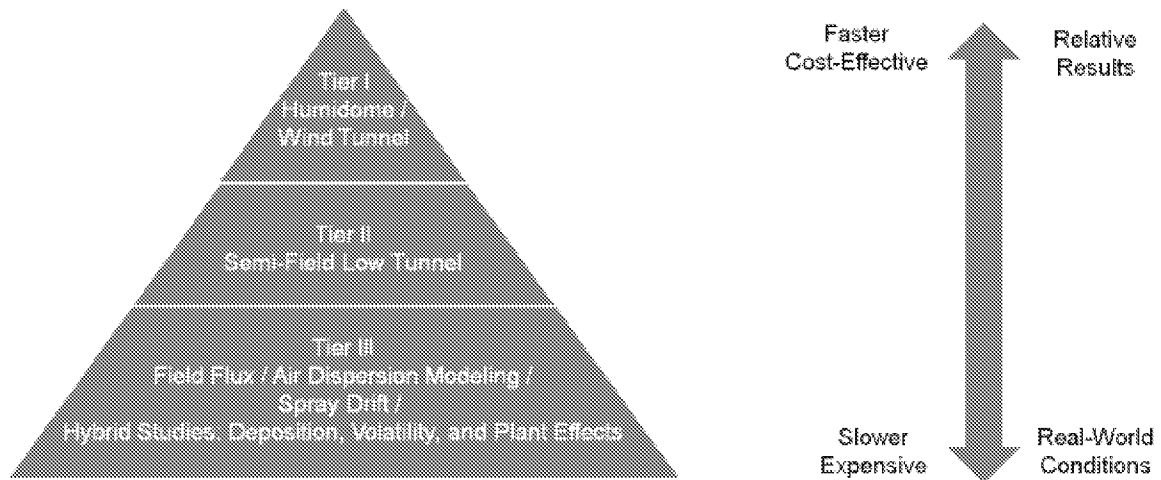
XMAX = XtendMax
PMAX = PowerMax
MON 51817 = VaporGrip X

RESTRICTED

Notes:

Results from 11 trials conducted by various academic indicate that adding VaporGrip to the tank further lowers visual symptomology on soybeans.

VaporGrip X OTM characteristics tested using a tiered approach



12

© 2009 CropScience

RESTRICTED

Notes:

VaporGrip X provides comparable spray drift deposition in field trials

Active	Adjuvants	Buffer (ft)	Mean Wind Speed (mph)	Max Wind Speed (mph)
XMax		28	9.2	12.5
XMax + PMax	Intact +	35	7.8	11.3
MON 119151	VaporGrip X	34	9.4	12.3

MON 119151 is a premix formulation of dicamba and glyphosate.
All three trials were conducted with TTI11004 nozzle at 53 psi.

10

© 2012 Bayer CropScience

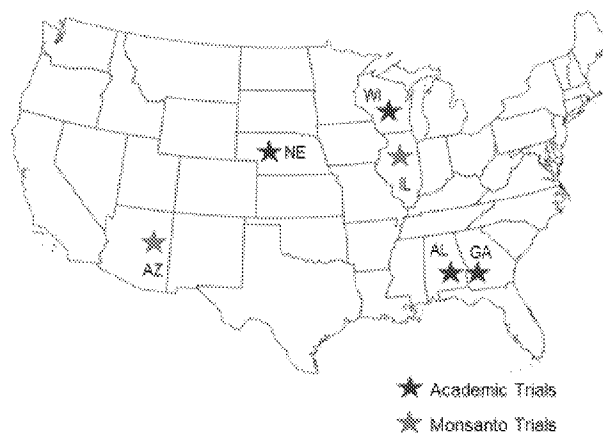
RESTRICTED

Notes:

- Including additional VaporGrip as a tank mix adjuvant was tested in a field spray drift deposition study conducted under EPA OPPTS 840.1200 guideline.
- Results are comparable to the previous spray drift study conducted without VaporGrip X
- Please note: The VGX study applications were conducted when temperatures were in the low 50's; while in the lower allowable range of the EPA Guideline not optimal for promoting % fines

VaporGrip X tested in six field volatility studies

- Applied XtendiMax + PowerMax + Intact + VaporGrip X on DT soybeans
- Measure on-site and off-site air concentration and meteorology at multiple heights
- Studies conducted for 3 – 7 days
- Calculate volatile mass loss using EPA-prescribed flux models
- Air dispersion modeling conducted for Monsanto trials to estimate off-target air concentration

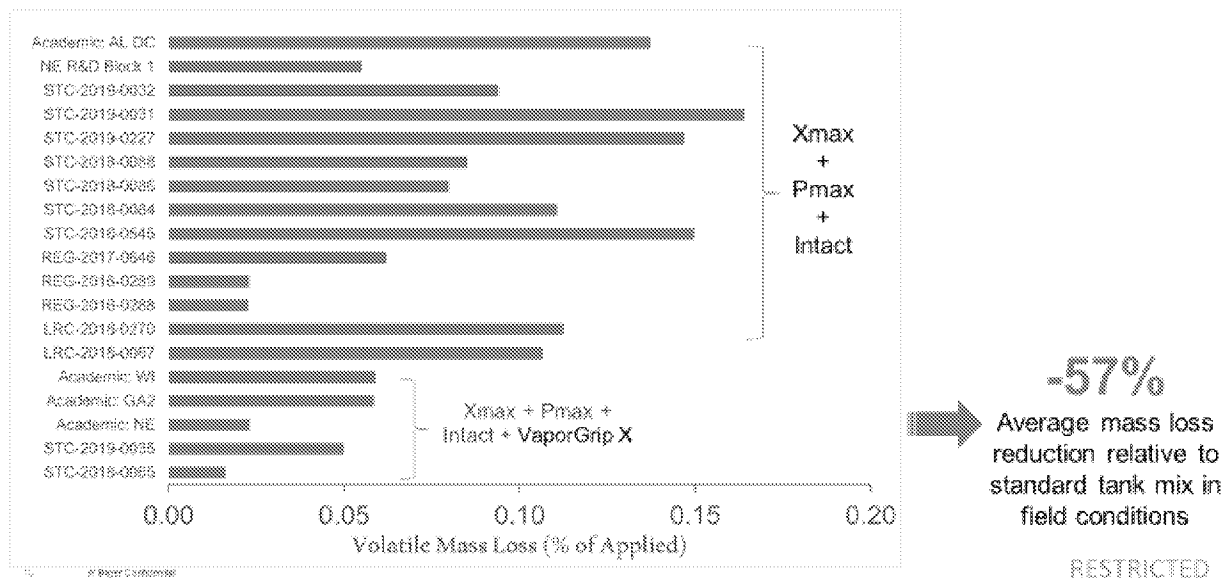


12 00 Paper 0000000000

RESTRICTED

Notes:

VaporGrip X further reduces volatile mass loss in flux studies



Notes:

Additional VaporGrip as tank mix adjuvant provides further reduction in volatile mass loss.

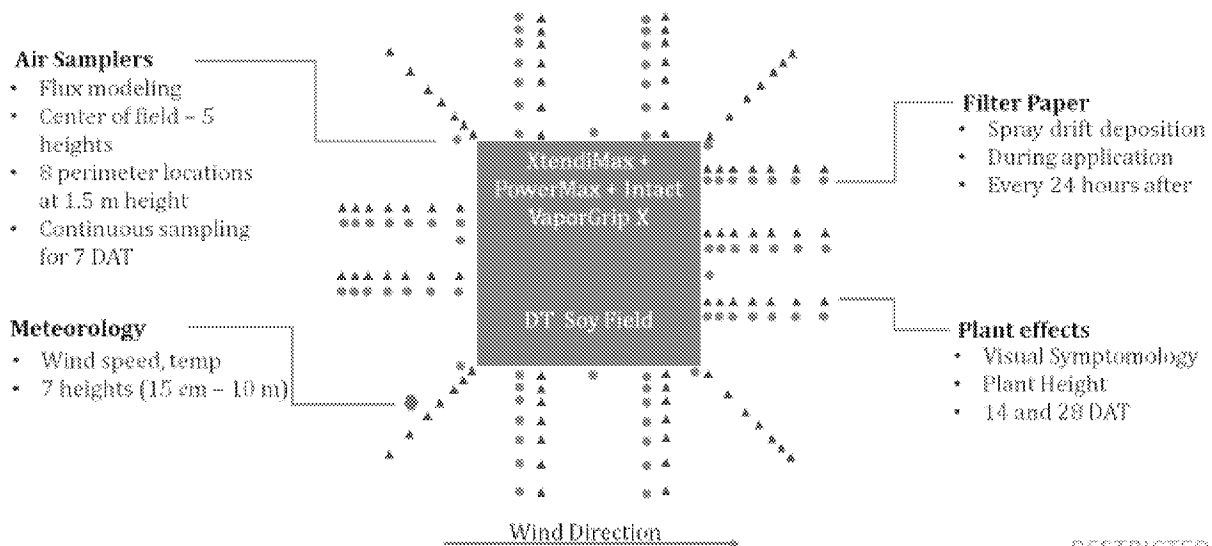
The above graph provides data from 19 field volatility studies.

Five studies were conducted by academics, fourteen (STC, LRC, REG) by Monsanto

Fourteen studies had standard tank mix (Xmax + Pmax + Intact), Five studies had additional VaporGrip

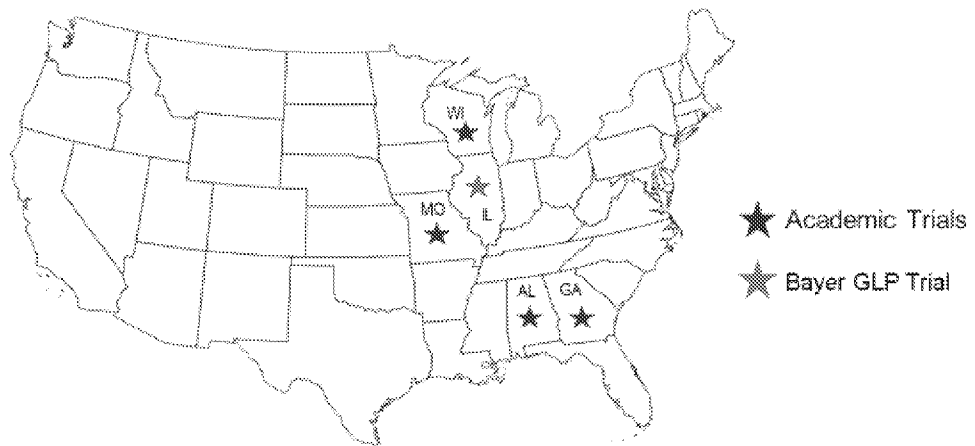
On average VaporGrip X reduced volatile mass loss by about half (0.09% Vs. 0.06%)

Hybrid field studies tie together deposition, volatility, and plant effects simultaneously



Notes:

VaporGrip X tested in five hybrid field studies



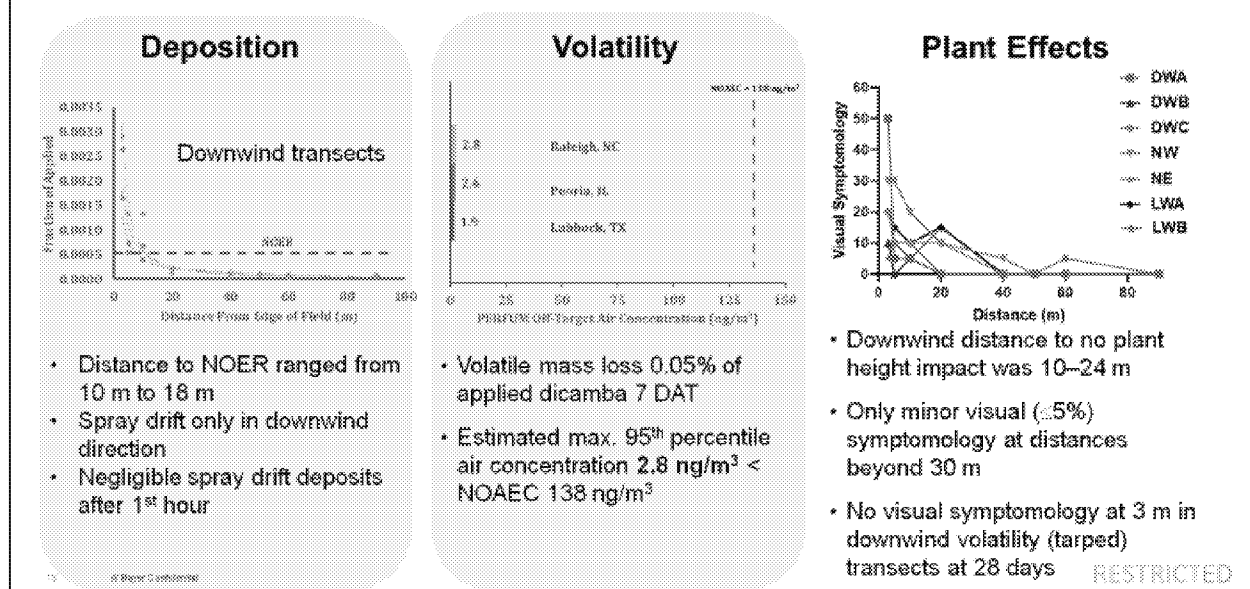
10

© Bayer Corporation 2006

RESTRICTED

Notes:

VaporGrip X delivers comparable deposition, lower volatile mass loss, and reduced plant symptomology (Bayer Trial - IL)



Notes:

Approximately 21 acres was sprayed in a 117-acre field in Carlyle, IL. The application area was planted with dicamba-tolerant soybean while the surrounding area was planted with non-dicamba tolerant soybean. The spray application was made on July 2, 2019 near Carlyle, IL:

- MON 76980 (22 oz/A) + MON 79789 (32 oz/A) + Intact (0.5% v/v) + VaporGrip (1% v/v)

To determine the effects of off-target movement on dicamba sensitive soybeans, the downwind, right wind, left wind, and upwind assessment transects were immediately adjacent to the treated area (i.e. no buffer zone). Measurements to sensitive soybean plants were evaluated to a distance of approximately 90 m for the downwind transects. Although plant effect data was collected at both 15-d and 28-d post application, modeling and results are presented for the regulatory relevant timepoint of 28 days post application.

Deposition

Distance to NOER was between 10 to 18 m. Label buffer distance is 33 m.

Volatility

Flux modeling was conducted using AD, IHF and Indirect models. Flux was converted to mass loss and presented as percent of applied dicamba. Based on the maximum flux method, the highest volatile mass loss was 0.05% seven days after application. For the same tank mix (i.e. Xmax + Pmax), but without VaporGrip X, previous studies have typically resulted volatile mass loss about 0.1% on average. This indicates that VaporGrip X further reduces field volatility.

Plant Effects

Overall, the soybeans in the volatility transects exhibited only minor visual symptomology and no effects on plant height or symptomology due to volatility were observed in the covered downwind transects. Plant effects in the transects located downwind of the predominant winds at application were more pronounced (downwind, left wind, and NW corner). The distance to no impact on plant height in these transects ranged from 10 to 23.5 m.

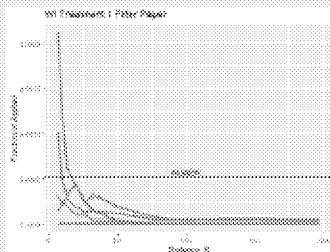
Academic field trials confirm Bayer trials



Ex. 6 Personal Privacy (PP)

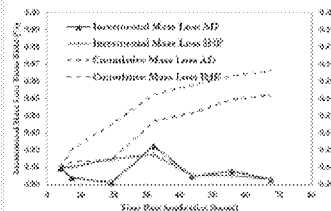
University of Wisconsin

Deposition



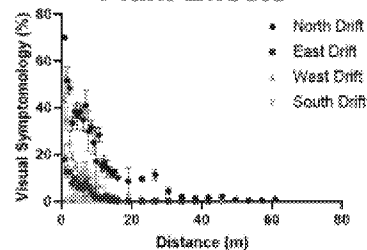
- Distance to NOER <6 m
- Spray drift only in downwind direction

Volatility



- Volatile mass loss 0.07% of applied dicamba 3 DAT

Plant Effects



- Downwind distance to no plant height impacts <10 m
- Only minor visual ($\leq 5\%$) symptomatology at distances beyond 30 m
- No effect on plant height observed in volatility transects

RESTRICTED

Notes:

- Distance to NOER <10 m with spray drift only in downwind direction
- Volatile mass loss was 0.07%. Air dispersion modeling was not conducted for this trial.
- Distance to no impact on plant height was less than 10 m, while <5% symptomatology at distances beyond buffer.

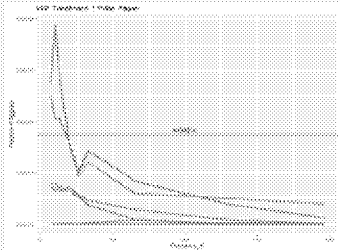
Academic field trials confirm Bayer trials



Ex. 6 Personal Privacy (PP)

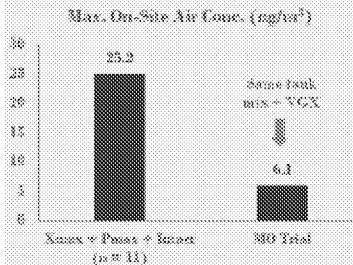
University of Missouri

Deposition



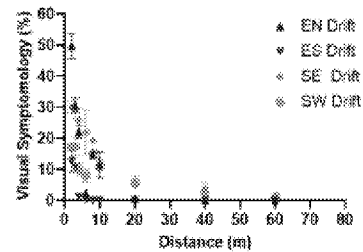
- Distance to NOER <6 m
- Spray drift only in downwind direction

Volatility



- Flux not calculated due to inadequate data
- Highest measured on-site air concentration 6.1 ng/m³
- Trials without additional VaporGrip have max. air conc. 25.2 ng/m³ (avg of 11 trials)

Plant Effects



- Downwind distance to no plant height impacts <10 m
- Only minor visual (<5%) symptomology at distances beyond 30 m
- No effects on plant height observed in volatility transects

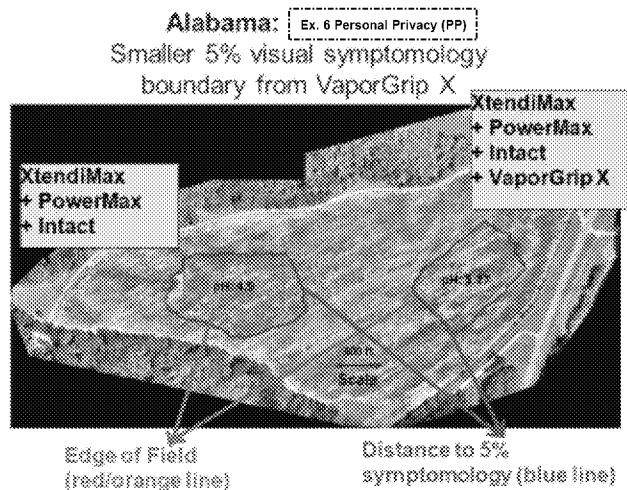
RESTRICTED

Notes:

- Distance to NOER <10 m with spray drift only in downwind direction
- Flux not calculated due to inadequate data, but we compared the max on-site concentration with 11 previous trials without VGX. We see considerable reduction in air concentration even on the field.
- Distance to no impact on plant height was less than 10 m, while <5% symptomology at distances beyond buffer.

Academic field trials confirm Bayer trials

(Dr. Steve Li, Auburn University; Dr. Stanley Culpepper, University of Georgia)



Georgia: Ex. 6 Personal Privacy (PP)

- Dr. Culpepper tested two side-by-side (8-acre plots)
 - Xmax + Pmax + Intact (with irrigation)
 - Xmax + Pmax + Intact + VaporGrip X
- Volatile mass loss with irrigation (0.02%) was lower than without irrigation (0.06%)
- No effect on plant height beyond 50 ft

Notes:

We are still processing some data from two additional academic studies

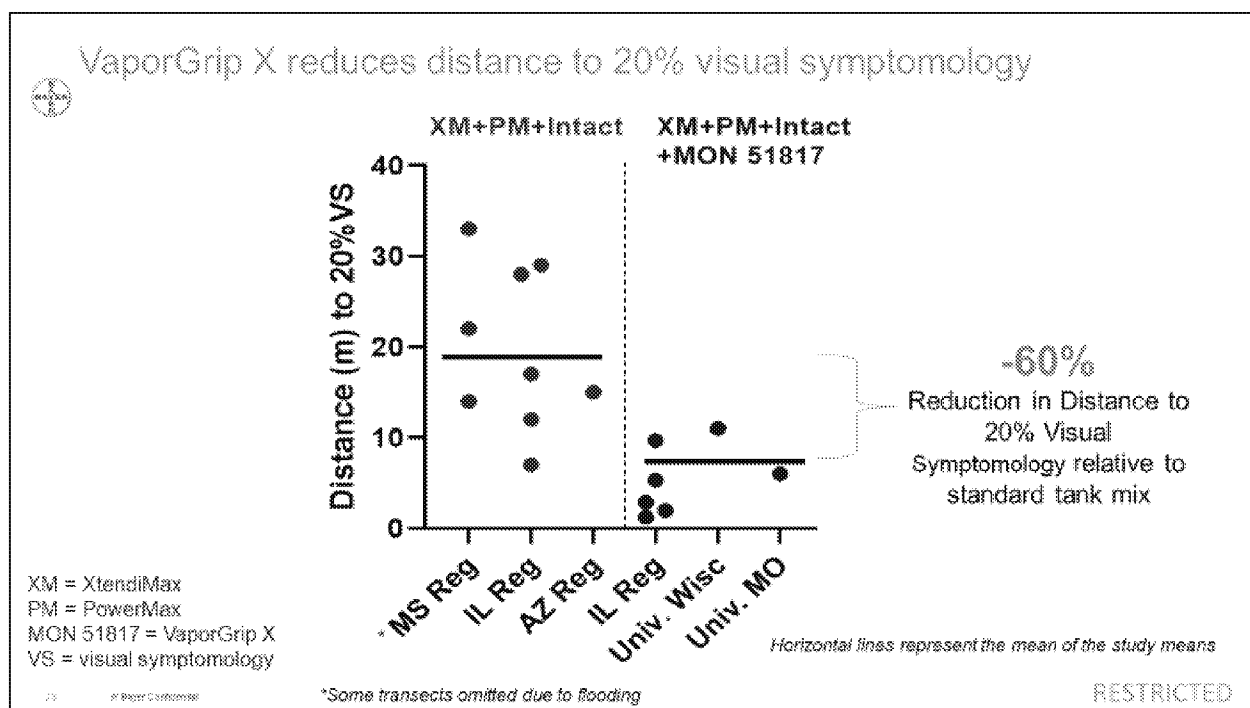
Alabama

- Ex. 6 Personal Privacy (PP) at Auburn Univ. tested on two side-by-side plots (5 acres plots)
- Left plot had standard tank mix, right plot had standard tank mix + VGX
- He then walked the 5% visual symptomology line.
- The 5% visual symptomology boundary is much smaller with VGX

Georgia

- Similar to AL, Ex. 6 Personal Privacy (PP) had two side-by-side plots of 8 acre
- Plot 1: Xmax + Pmax + Intact with irrigation
- Plot 2: Xmax + Pmax + Intact + VaporGrip X
- He irrigated 2 hours after application and lasted for about 7 hours
- Mass loss was lower with irrigation than without
- He saw no impact on plant height beyond 50 ft. using potted plants

RESTRICTED



Notes:

Summary of 2018/2019 studies

MRIDs

51017501 MS

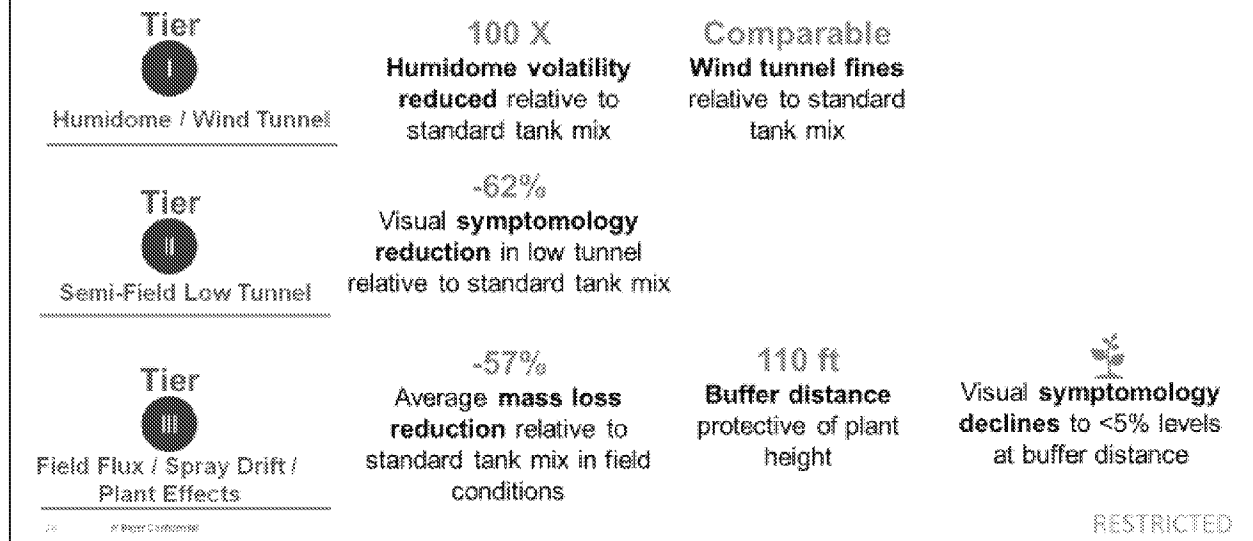
51017502 IL

50642801 AZ

Black horizontal line in the graph is the mean of the study means

20% visual symptomology was considered by EPA as a surrogate for a 5% effect on plant height.

Conclusion: VaporGrip X testing using a tiered-approach shows further improvement in OTM profile of dicamba



Notes:

Key results from VaporGrip Studies

- Two orders of magnitude reduction in volatility in the humidome relative to standard tank mix
- As expected, wind tunnel fines remain comparable
- 62% reduction in visual symptomology under low tunnels relative to standard tank mix, these studies were conducted by academics from 11 states
- 57% reduction in average mass loss relative to standard tank mix in field conditions based on five flux studies (three conducted by academics)
- Current label buffer distance of 110 ft is protective of plant height
- Visual symptomology declines to <5% levels at buffer distance in based on five field studies (four conducted by academics)



VaporGrip X is a means of improving the OTM profile and should be considered during decision making

Continuous innovation leads to further improved performance and increased margin of safety

- VaporGrip X: including additional VaporGrip as a tank mix partner/adjuvant for increased buffering and proton-scavenging capacity to further reduce volatility potential

- 2019** • Research by academics and Bayer confirms VaporGrip further improves the OTM profile of XtendiMax, including other formulations and key tank mixes
- 2020** • MON 51817 (VGX) is already listed as a tank mix adjuvant on the XtendiMax website
• The available VGX data can be incorporated into the 2020 re-registration decision
- 2021** • Even if EPA does not require VGX as part of the 2020 XtendiMax re-registration decision, Bayer currently plans to recommend VGX for all applications of XtendiMax
• Assessing options for commercializing adjuvants that contain both VaporGrip X and Drift Reducing Agents

25

© Bayer Corporation 2020

RESTRICTED

Notes:



Notes: